

Enclosure C

Overview of Monitoring Data and PPE Requirements

DRY CHRYSOTILE ASBESTOS QUANTITY OVERVIEW

Annually, the American Chemistry Council's Chlorine Chemistry Division (CCD) member companies use an average of 440 tons of dry chrysotile asbestos to maintain diaphragm production at nine diaphragm-technology locations in the United States.

EMPLOYEE INTERACTION

Among the CCD member facilities employing diaphragm technology, handling of dry asbestos is restricted to a total of about 50 employees, which represents about 3 percent of the total work force at these facilities.¹ The total amount of time spent handling dry asbestos at all of these facilities is estimated to be about 76 hours per week (1.6 hours/week per employee). This represents about 4 percent of the work week for these 50 employees, and about 0.1% of the total man hours at the facilities.

EMPLOYEE TRAINING

Only company employees (not contractors) are involved in the handling of dry asbestos. Having only company employees involved in the handling of dry asbestos:

- helps to ensure that medical monitoring is done properly and on time
- allows the company to have access to detailed medical records related to employees' jobs and take appropriate action to protect employees' health
- allows the company to maintain a highly-experienced and trained workforce, with a lower turnover rate, further allowing us to monitor our workers over time

New employees are trained extensively:

- Orientation
- General awareness training describing the requirements of the Occupational Safety and Health Administration (OSHA) asbestos standard,² including the effects of exposure as well as the risk of smoking and working with asbestos
- Procedures and procedure-use training, including procedures for safe handling and post-handling procedures to prevent carry-over exposure
- Job shadow/work with someone on each task
- All operators are certified in their roles. The certification covers a number of activities with a heavy focus on both proper asbestos handling techniques and proper PPE.
- Refresher training every three years

PPE USE AT EACH SITE

All operators, when handling dry asbestos or asbestos-containing materials wear the following PPE:

- | | |
|--|--------------------------|
| • Rubber Boots | • Respiratory Protection |
| • Tyvek® Coveralls (impervious suits) | • Rubber Gloves |
| • Safety Glasses (worn under hood or via goggle) | |

¹ Only company employees handle dry asbestos; no contract workers are used.

² OSHA Standard for Toxic and Hazardous Substances, Asbestos (29 CFR §1910.1001).

POST HANDLING PROCEDURES

All sites are equipped with controls to prevent asbestos exposure. For example, specific dedicated areas for decontamination and clean rooms with a shower in between, prevent carry-over exposure to other portions of the facilities or employees. Air is filtered to prevent the release of fibers. The post-handling procedures, including proper disposal of all PPE, are followed each time the dry asbestos is handled.

MEDICAL MONITORING DATA

The companies have a long-standing rigorous medical monitoring protocol to track operators in areas with a risk of exposure to asbestos containing materials. The program includes pre-placement baseline physicals, periodic physicals and post placement physicals.

Preplacement Examination

The preplacement examination for those workers with potential assignments in areas where exposure to dry asbestos is possible includes but is not limited to:

- medical and work history
- physical examination of all systems with emphasis on the respiratory system, the cardiovascular system and the digestive tract
- completion of the respiratory disease standardized questionnaire
- chest roentgenogram (posterior-anterior 14x17 inches)
- pulmonary function tests to include forced vital capacity (FVC) and forced expiratory volume at 1 second (FEV1)
- any additional tests deemed appropriate by the examining physician

Periodic Examination

Periodic examination consisting of the same basic components as the preplacement exam is made available to employees who fall under medical asbestos standards with the established permissible exposure limit.

Periodic chest roentgenograms are conducted in accordance with the OSHA standard as indicated below:

Years Since First Exposure	Age of Employee		
	15 to 35	35+ to 45	45+
0 to 10	Every 5 years	Every 5 years	Every 5 years
10+	Every 5 years	Every 2 years	Every 1 year

A termination of employment medical examination is made available to any employee who has been exposed to airborne concentrations of asbestos fibers at or above the action level and/or excursion limit. Additional exams would be provided if an employee was to exhibit any signs or symptoms associated with exposure to asbestos

EXPOSURE MONITORING DATA

Exposure monitoring is conducted in accordance with the requirements of the OSHA asbestos standard.

Area Monitoring

- Site must quantify exposures (shift averages as well as task averages) to ensure the action, permissible or excursion limits are not exceeded
- If exposures were to exceed those limits more frequent sampling, medical monitoring and training would be required
- Sites have been significantly below the Permissible Exposure Limit of 0.1 fiber/cc for shift average and 1 fiber/cc for excursion limit
- Regardless of results, companies perform annual area monitoring sampling within areas where dry asbestos is present

Task Specific Monitoring

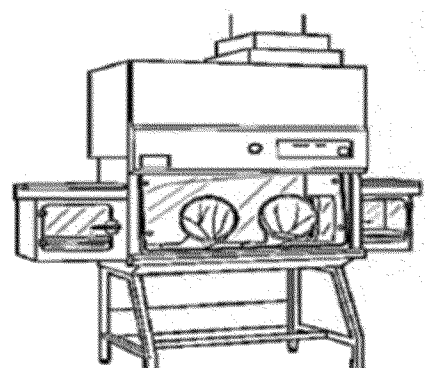
- Site must quantify exposures (shift averages as well as task averages) to ensure the action, permissible or excursion limits are not exceeded
- If exposures were to exceed those limits more frequent sampling, medical monitoring and training would be required
- Workers adhere to strict procedures, housekeeping, and personal protective equipment and keep the material wet or encapsulated to maintain low risk to workers' health and prevent release of the material into the environment.

Representative Glove Box Design and Emissions Data

Once the bags of dry asbestos enter the facility it is stored in a secure area where it remains until it is needed for the diaphragm preparation process. At the time, the bags are transferred to a glove box or ventilated hood where they are opened and then transferred to a mixing tank via a closed system.

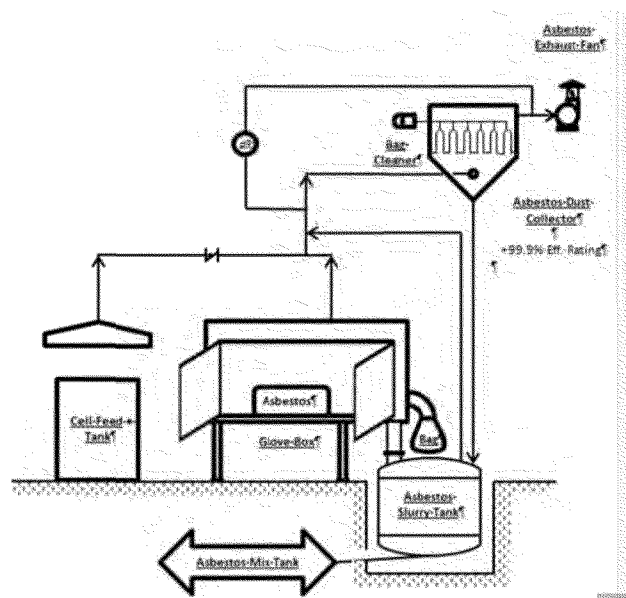
All facilities comply with the National Emission Standard for Hazard Air Pollutants (NESHAP) for asbestos.³ Facilities generally use vacuum systems equipped with +99.9% efficient filters monitored via daily and weekly inspections. Once processed (debagged and/or put into a glove box), the asbestos is always wet or encapsulated. There is no further handling of dry asbestos.

Workers adhere to strict procedures, housekeeping, and personal protective equipment and keep the material wet or encapsulated to maintain low risk to workers' health and prevent release of the material into the environment. The diagram below provides an overview of the systems used.



Sample Glove Box

³ EPA. *National Emission Standard for Hazardous Air Pollutants ("NESHAP"), National Emission Standard for Asbestos* (40 CFR § 61.140).



The water used to maintain the wet state is captured in the trench system. The trench system flows to the clarifier where the solids are collected. Any solids that overflow out of clarifier with the water are filtered with a separator which screens particles as fine as 37 microns. This keeps all solids in the clarifier. The water is recycled back into the system to be used for washing anodes. The filtered solids are dropped back into the trench system and continuously recirculated through the process. When solids build up inside the clarifier they are pulled out, dewatered, and sent to an off-site approved landfill for disposal.

During rain events or other times when the flow to the clarifier is high, the excess water overflows to a piping system through a weir and sent to the environmental treatment plant and treated before being discharged.

Ambient Air Monitoring and PPE Summary, 1996 - 2016

Infographic Process Stage ¹	Process Description	Tasks	Range of Results (f/cc) ²	PPE Requirements
Short-Term (15-minute) Sampling				
1	The port of entry receives asbestos in sealed shipping containers. The material is packaged in dust-proof woven plastic bags on wooden pallets that have been shrink-wrapped in plastic. The container is marked per DOT requirements and is shipped to the plant unopened.	Throughout the importation tasks the material is sealed and contained in a dust-woven bag, as described in process description. The steps do not occur at the site, and there is no potential exposure or OSHA requirement for exposure monitoring.		
2	Asbestos is unloaded and stored in an isolated, enclosed area with restricted access limited to only trained personnel per OSHA regulations.	Asbestos unloading/transport	<0.01 - 0.12	<input type="checkbox"/> Standard PPE ³ <input type="checkbox"/> Chemical Resistant Boots <input type="checkbox"/> Respirator (Half-face with HEPA cartridges; ⁴ APF = 10 ⁵) <input type="checkbox"/> Work Gloves <input type="checkbox"/> Disposable Particulate Suit
3	Raw asbestos is transported in the dust proof woven plastic bags to a glove box as needed for diaphragm preparation. Personnel monitoring is conducted for full shifts and specific tasks.	Glovebox weighing and asbestos handling	<0.001 -1.7	<input type="checkbox"/> Standard PPE <input type="checkbox"/> Chemical Resistant Boots <input type="checkbox"/> Respirator (PAPR with HEPA cartridges; APF = 25) <input type="checkbox"/> Disposable Chemical Gloves <input type="checkbox"/> Disposable Particulate Suit
4	Asbestos is mixed with caustic soda and salt to create a "slurry." Halar or Teflon modifiers are added to the slurry to allow for handling/storage in a dry non-friable form.	Asbestos Slurry	<0.016 - 0.04	<input type="checkbox"/> Standard PPE <input type="checkbox"/> Goggles <input type="checkbox"/> Chemical Resistant Boots <input type="checkbox"/> Dedicated Waterproof Gloves <input type="checkbox"/> Disposable Particulate Suit
5	The asbestos slurry is deposited onto a screen and is dried in an oven to sinter the Halar or Teflon fibers to the asbestos, forming a non-friable asbestos diaphragm.	Depositing	<0.001 - 0.1	<input type="checkbox"/> Standard PPE <input type="checkbox"/> Goggles <input type="checkbox"/> Chemical Resistant Boots <input type="checkbox"/> Dedicated Waterproof Gloves <input type="checkbox"/> Disposable Particulate Suit

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Infographic Process Stage ¹	Process Description	Tasks	Range of Results (f/cc)	PPE Requirements
6	The diaphragm is inspected and physically joined with other parts of the electrolytic cell and sealed. It is then ready to be placed in service.	Cell Assembly	<0.008-0.154	<input type="checkbox"/> Standard PPE <input type="checkbox"/> Work Gloves <input type="checkbox"/> Chemical Boots
7	Asbestos is mostly inert and separates the sodium hydroxide (caustic soda), hydrogen, and chlorine. Asbestos is confined within the production process.	No asbestos-related tasks are performed at this step. Asbestos is contained within the cell and remains in a closed-loop manufacturing process.		
8	Diaphragms need to be replaced periodically, while other parts may be reused. An operator uses wet methods (e.g. high pressure water) to remove the non-friable asbestos coating from the diaphragm. The water and solids are sent to the filter press where excess water is removed.	Cell Disassembly	<0.01 - 0.45	<input type="checkbox"/> Standard PPE <input type="checkbox"/> Goggles <input type="checkbox"/> Chemical Gloves <input type="checkbox"/> Disposable Particulate Suit <input type="checkbox"/> Chemical Boots
		Hydroblasting	<0.02 - 0.51	<input type="checkbox"/> Standard PPE <input type="checkbox"/> Respirator (Loose fitting hood with continuous flow breathing air; APF = 25) <input type="checkbox"/> Dedicated Waterproof Chemical Gloves <input type="checkbox"/> Dedicated Rain/Chemical Suit <input type="checkbox"/> Chemical Boots
		Filter Press	<0.003 - 0.2	<input type="checkbox"/> Standard PPE <input type="checkbox"/> Goggles <input type="checkbox"/> Chemical Gloves <input type="checkbox"/> Disposable Particulate Suit <input type="checkbox"/> Chemical Boots
9	The filtered solids are transferred into bulk bags or lined dumpsters that are tightly sealed and marked per federal and state regulations. The solids are then disposed in landfills licensed to accept asbestos containing waste.	Filter Press waste disposal monitoring data is encompassed in the Filter Press task as noted in Process Stage 8. Other waste disposal activities during this step are captured as part of the full-shift monitoring data, presented below.		<input type="checkbox"/> Standard PPE ³ <input type="checkbox"/> Chemical Resistant Boots <input type="checkbox"/> Respirator (PAPR with HEPA ⁴ cartridges; APF ⁵ = 25) <input type="checkbox"/> Disposable Chemical Gloves <input type="checkbox"/> Disposable Particulate Suit

Infographic Process Stage ¹	Process Description	Tasks	Range of Results (f/cc)	PPE Requirements
Full-Shift (8-hour) Sampling				
	Full-shift sampling encompasses all asbestos-related tasks associated with Cell Renewal/Cell Repair activities that occur during an 8-hour shift. These full-shift samples were collected in addition to the short-term (task) samples.		<0.001 - 0.11	PPE worn is dictated by the specific tasks being performed at the time. See specific tasks listed above.
¹ Short-term task samples are correlated to the specific Infographic Process Stage. ² The low end of the range represents the Limit of Detection (LOD). The LOD is the amount of the substance that can be reliably reported based on the analytical method and laboratory's instrumentation. Results are indicative of ambient air; workers are protected from exposure by required PPE. ³ Standard PPE generally includes the following (may vary by location and/or area): hard hat, safety glasses, steel-toed shoes, and earplugs as required. ⁴ P-100 (HEPA) cartridge filters capture 99.97% of the 0.3-micron (0.000012-inch) or larger particles in the air passing through the filter. ⁵ Assigned Protection Factor (APF) for respirators: Half-face air purifying respirator = 10; Loose fitting hood with continuous flow breathing air = 25; Loose fitting PAPR = 25; Tight fitting PAPR = 1,000. To determine the Maximum Use Concentration for respirators, multiply the Assigned Protection Factor and the Permissible Exposure Limit. For example, for an APF of 10 used with a substance that has a 1 f/cc permissible exposure limit can be expected to provide the appropriate protection up 10 f/cc [10 (APF) x 1 (PEL)].				

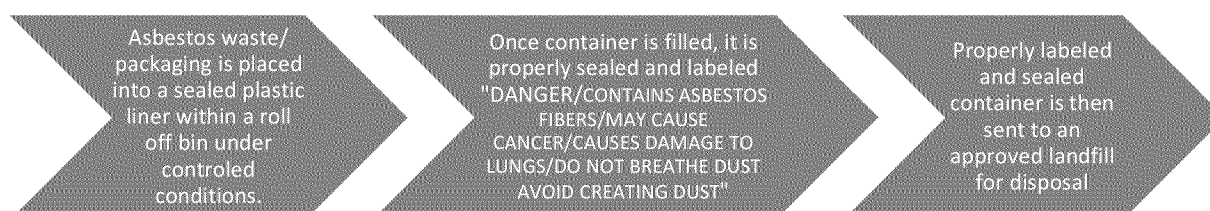
TRANSPORTATION, REMOVAL AND DISPOSAL

- Workers adhere to strict procedures, housekeeping, and personal protective equipment to maintain low risk to workers' health and prevent release of the material into the environment
- All containers used for disposal of asbestos waste are labeled and sealed according to regulations and taken to the designated storage area for the exclusive collection of asbestos waste
- All waste is sent to non-hazardous landfills that are approved for asbestos waste

Transportation



Removal and Disposal



ACTUAL USE COMPARISON TO TRI DATA REPORTED BY CCD MEMBER COMPANIES

Site	2015 TRI On-site Friable Asbestos Air Emissions (lbs)	2015 TRI Offsite Friable Asbestos Waste Transfers (lbs)	Basis
Site 1	--	--	Based on manufacturer's data. Baghouse efficiency (99.9%), 1 hour per day, 5 days/week ==> 0.1337 pounds per year to air (below reporting threshold). Waste transfers consist of non-friable asbestos containing material (ACM).
Site 2	--	283,512	Landfill Disposal (no air emissions). Based on full weight which includes cell components as well as asbestos. Asbestos only constitutes <8% of the total weight reported.
Site 3	--	--	No TRI data submitted in 2015. Below reporting threshold.
Site 4	--	--	Air is recycled, no discharge to atmosphere. Waste transfers consist of non-friable ACM.
Site 5	0.76	12.07	Annual air emissions estimated based on control efficiency of air cleaning device. Waste transfers account for friable percentage of ACM.
Site 6	20.00	--	Default value from State NSR air permit reported. Annual air emissions estimated to be less than 1 lb. based on control efficiency of air cleaning device. Waste transfers consist of non-friable ACM.
Site 7	--	--	TRI Reporting done on Form A, air releases and waste transfer data not in EPA TRI Database. Annual air emissions estimated to be less than 1 lb.
Site 8	0.07	739	Annual air emissions estimated based on control efficiency of air cleaning device. Waste transfers account for friable percentage of ACM.
Site 9	--	--	No TRI data submitted in 2015. Below reporting threshold.